

Seat No.

Total No. of Pages : 6

Ph.d Entrance Examination March - April, 2026**PHYSICS****Sub. Code: 58795****Day and Date : Tuesday, 06-Oct-2026****Total Marks : 100****Time : 10.00 am to 12.00 pm****Instruction :**

- 1) All questions are compulsory.
- 2) Each question carries 2 marks.
- 3) Answers should be marked in the given OMR answer sheet by darkening the appropriate option.
- 4) Use black ball point pen only for marking the circle. Do not make any stray mark on the OMR answer sheet.
- 5) Follow the instructions given on OMR Sheet.
- 6) Rough work shall be done on the sheet provided at the end of question paper.
- 7) Only non-programmable calculators are allowed.

- 1) The Hamiltonian of a one-dimensional harmonic oscillator is $H = \frac{p^2}{2m} + \frac{1}{2}m\omega^2 q^2$. The Poisson bracket $[q, H]$ is equal to :

A) p	B) $\frac{p}{m}$
C) $-m\omega^2 q$	D) $m\omega^2 q$
- 2) If a generalized coordinate has the dimensions of an angle, then the corresponding canonical momentum has the dimensions of :

A) Energy	B) Force
C) Linear momentum	D) Angular momentum
- 3) If the Lagrangian of a system does not contain time explicitly, then the conserved quantity is :

A) Total linear momentum	B) Total angular momentum
C) The Hamiltonian of the system	D) The generalized velocity
- 4) In a central force field the areal velocity of the particle remains constant because:

A) Its energy is conserved	B) Its linear momentum is conserved
C) Its angular momentum is conserved	D) The force is always inverse square
- 5) A Carnot engine operates between a source at 500 K and a sink at 300 K. Its efficiency is :

A) 40%	B) 60%
C) 33%	D) 20%
- 6) At the same temperature, the rms speed of oxygen molecules ($M = 32$) compared with that of hydrogen molecules ($M = 2$) is :

A) One sixteenth	B) 4 times larger
C) One fourth	D) Equal
- 7) For an ideal Bose gas below the condensation temperature, the chemical potential is :

A) Large and positive	B) Equal to zero
C) Equal to the Fermi energy	D) Equal to kT
- 8) According to the Debye model, the low temperature lattice specific heat of a two-dimensional solid varies with temperature as :

A) T^2	B) T^3
C) $T^{\frac{3}{2}}$	D) T

- 9) The electric field of a plane electromagnetic wave in free space is $E = E_0 \cos(6 \times 10^8 t - 2y) \hat{z}$ V/m. The wavelength of the wave is :
 A) 3.14 m B) 6.28 m
 C) 1.57 m D) 2.00 m
- 10) A point charge $+q$ is kept at a distance d in front of an infinite grounded conducting plane. The total charge induced on the plane is :
 A) Zero B) $-q$
 C) $+q$ D) $-\frac{q}{2}$
- 11) The vector potentials A and $A' = A + \nabla\chi$ describe the same :
 A) Magnetic field B) Charge density
 C) Gauge function D) Scalar potential
- 12) A particle is in the $n = 3$ state of a one-dimensional infinite potential well of width a . The number of nodes of the wave function strictly inside the well is :
 A) One B) Two
 C) Three D) Zero
- 13) For the ground state of a one-dimensional harmonic oscillator, the uncertainty product $\Delta x \cdot \Delta p$ is :
 A) Zero B) $\hbar/2$
 C) $\hbar$ D) $2\hbar$
- 14) Two identical spin-half particles are in a triplet spin state under the exchange of the two particles, their space wave function must be :
 A) Identically zero B) Symmetric
 C) Antisymmetric D) Either symmetric or antisymmetric
- 15) The term symbol for the ground state of the nitrogen atom ($1s^2 2s^2 2p^3$) is :
 A) $^2P_{\frac{1}{2}}$ B) $^3P_0$
 C) $^2D_{\frac{5}{2}}$ D) $^4S_{\frac{3}{2}}$
- 16) The pure rotational absorption spectrum of a rigid diatomic molecule shows lines separated by $2B$. The separation between successive Stokes lines in its rotational Raman spectrum is :
 A) $6B$ B) B
 C) $2B$ D) $4B$
- 17) The binding energy per nucleon curve attains its maximum value near mass number :
 A) 56 B) 120
 C) 208 D) 26
- 18) The free neutron decay $n \rightarrow p + e^- + \text{antineutrino}$ conserves :
 A) Charge, lepton number and baryon number
 B) Lepton number only
 C) Strangeness only
 D) Charge only
- 19) For a face centred cubic (FCC) lattice, the X-ray reflection observed at the smallest Bragg angle corresponds to the plane :
 A) (100) B) (110)
 C) (111) D) (210)
- 20) The number of acoustic branches in the phonon dispersion of a three-dimensional crystal is :
 A) 3 B) $3p - 3$
 C) $3N$ D) 2

- 21) The eigenvalues of the matrix having rows $(0, -i)$ and $(i, 0)$ are :
 A) $+i$ and $-i$ B) 0 and 1
 C) $+2$ and -2 D) $+1$ and -1
- 22) A canonical transformation is generated by the generating function $F_2(q, P) = qP$. The resulting transformation is :
 A) $Q = p, P = -q$ B) $Q = -q, P = -P$
 C) $Q = q^2, P = p^2$ D) The identity transformation
- 23) The residue of the function $f(z) = \frac{e^z}{(z-1)^3}$ at $z = 1$ is :
 A) $\frac{e}{6}$ B) $\frac{e}{2}$
 C) e D) $2e$
- 24) A relativistic particle of rest mass m has kinetic energy exactly equal to its rest energy. Its linear momentum is :
 A) $2mc$ B) $\sqrt{2} mc$
 C) $\sqrt{3} mc$ D) mc
- 25) Three non-interacting electrons are placed in a one-dimensional infinite potential well of width a at $T = 0$ K. The total ground state energy of the system is :
 A) $\frac{7\pi^2\hbar^2}{2ma^2}$ B) $\frac{3\pi^2\hbar^2}{2ma^2}$
 C) $\frac{9\pi^2\hbar^2}{2ma^2}$ D) $\frac{3\pi^2\hbar^2}{ma^2}$
- 26) Research undertaken mainly to extend the frontiers of knowledge, without any immediate commercial application, is called :
 A) Evaluation research B) Applied research
 C) Fundamental research D) Action research
- 27) A hypothesis which states that there is no significant difference between two sets of observations is known as :
 A) Directional hypothesis B) Working hypothesis
 C) Null hypothesis D) Alternative hypothesis
- 28) The most effective way of avoiding plagiarism in a research report is :
 A) Rewriting the sentences using synonyms
 B) Proper citation and acknowledgement of every source used
 C) Translating the material into another language
 D) Restricting the report to a small number of pages
- 29) Drawing a general conclusion from a set of particular observations is an example of :
 A) Analogical reasoning B) Circular reasoning
 C) Deductive reasoning D) Inductive reasoning
- 30) In chemical bath deposition, the formation of a uniform and well adherent film on the substrate is favoured by :
 A) Complete absence of any complexing agent
 B) Rapid homogeneous precipitation in the bulk of the bath
 C) Slow heterogeneous nucleation and growth on the substrate surface
 D) Vigorous boiling of the bath throughout the deposition
- 31) One complete cycle of the SILAR method consists of the sequence:
 A) Immersion, dwelling, withdrawal, drying
 B) Adsorption, rinsing, reaction, rinsing

- C) Evaporation, condensation, adsorption, drying
D) Atomization, transport, decomposition, annealing
- 32) In the spray pyrolysis technique, the substrate temperature mainly governs:
A) The thermal decomposition of the precursor on the substrate
B) The pressure of the carrier gas
C) The viscosity of the precursor solution
D) The size of the aerosol droplets
- 33) Galvanostatic mode of electrodeposition means that the deposition is carried out at constant:
A) Potential
B) Current
C) Temperature
D) Resistance
- 34) In the dip coating technique, the thickness of the deposited film increases with:
A) Decreasing solution viscosity
B) Decreasing solution concentration
C) Increasing dwell time only
D) Increasing withdrawal speed
- 35) In spin coating, the final film thickness t varies with the angular speed ω of the substrate approximately as:
A) $t \propto \omega^{-\frac{1}{2}}$
B) $t \propto \omega^2$
C) $t \propto \omega^{\frac{1}{2}}$
D) $t \propto \omega$
- 36) The essential difference between hydrothermal and solvothermal synthesis lies in the :
A) Colour of the precursor
B) Speed of stirring
C) Shape of the autoclave used
D) Nature of the solvent employed
- 37) The radiation resistance of a half-wave dipole antenna in free space is nearly:
A) 377Ω
B) 50Ω
C) 73Ω
D) 300Ω
- 38) In a superheterodyne receiver, the intermediate frequency is generated in the :
A) Audio amplifier
B) RF amplifier
C) Mixer stage fed by the local oscillator
D) Detector stage
- 39) The working principle of a SQUID magnetometer is based on :
A) The Lorentz force on moving charges
B) Josephson tunnelling and flux quantization
C) Faraday's law of induction alone
D) The Hall effect in thin films
- 40) In X-ray diffraction, the Scherrer formula is employed to estimate the:
A) Crystallite size
B) Atomic scattering factor
C) Preferred orientation
D) Lattice strain
- 41) In SEM imaging, the contrast produced by backscattered electrons is mainly governed by the:
A) Electrical conductivity of the stage
B) Surface topography only
C) Average atomic number of the region
D) Magnetic domain structure
- 42) In the non-contact mode of AFM, the oscillating tip is held:
A) Slightly above the surface, in the attractive van der Waals regime
B) In intermittent contact with the surface
C) Inside the bulk of the sample
D) In hard contact with the sample surface

- 43) In differential thermal analysis (DTA), the quantity recorded as a function of temperature is the :
 A) Volume change of the sample
 B) Electrical resistance of the sample
 C) Change in mass of the sample
 D) Temperature difference between the sample and an inert reference
- 44) The Hall coefficient of a semiconductor sample is found to be negative. The majority charge carriers in the sample are :
 A) Holes
 B) Electrons
 C) Positive ions
 D) Phonons
- 45) In a diffuse reflectance UV-Vis study, the optical band gap of a semiconductor is normally obtained from :
 A) A Tauc plot of $(\alpha h\nu)^n$ against $h\nu$
 B) A plot of absorbance against concentration
 C) A plot of transmittance against time
 D) A plot of reflectance against sample mass
- 46) The same powder sample is scanned in XRD, once with Cu $K\alpha$ (1.54 Å) and once with Mo $K\alpha$ (0.71 Å). For the same set of lattice planes, the measured FWHM (in radian) will be :
 A) Larger with Cu $K\alpha$
 B) Exactly the same in both cases
 C) Zero in both cases
 D) Larger with Mo $K\alpha$
- 47) A quantity is computed as $z = \frac{x^2 y}{\sqrt{w}}$. The maximum fractional error in z is given by :
 A) $(\frac{\Delta x}{x}) + (\frac{\Delta y}{y}) + (\frac{\Delta w}{w})$
 B) $2(\frac{\Delta x}{x}) + (\frac{\Delta y}{y}) - (\frac{\Delta w}{2w})$
 C) $\sqrt{(\frac{\Delta x}{x})^2 + (\frac{\Delta y}{y})^2 - (\frac{\Delta w}{w})^2}$
 D) $2(\frac{\Delta x}{x}) + (\frac{\Delta y}{y}) + (\frac{\Delta w}{2w})$
- 48) Simpson's 3/8 rule of numerical integration gives exact results for polynomials up to degree:
 A) Two
 B) Three
 C) Four
 D) Five
- 49) For a simple root, the order of convergence of the Newton-Raphson method is :
 A) Two
 B) Three
 C) One
 D) 1.618
- 50) A Geiger-Müller counter having a dead time of 100 μ s records 4000 counts per second. The true counting rate is nearly:
 A) 5000 counts per second
 B) 8000 counts per second
 C) 4400 counts per second
 D) 6667 counts per second

:: ROUGH WORK ::